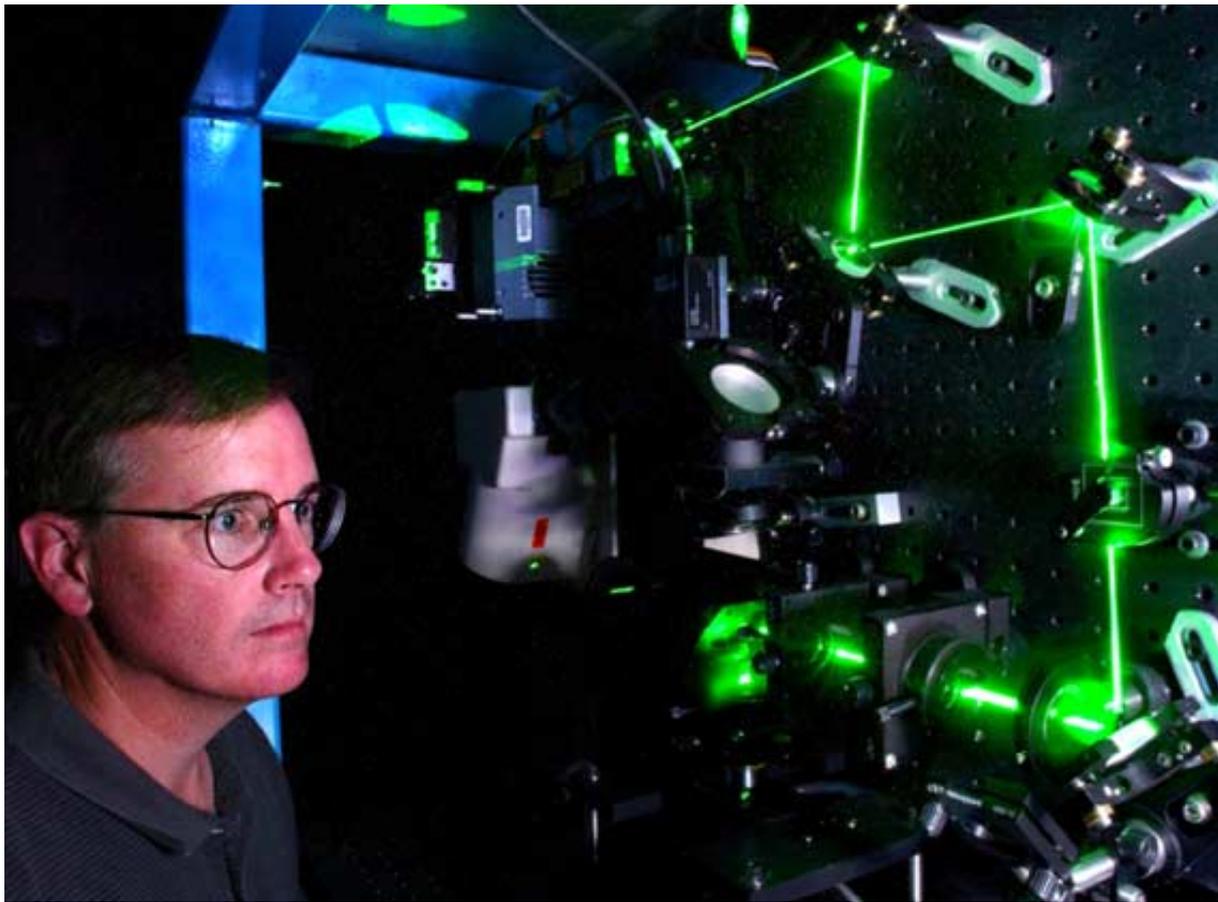


# Sandia/UNM collaborations may lead to new ways to diagnose, prevent illnesses using microarray technology

*Microarray scanning, computing technologies used in two collaborative projects*



**MICROARRAY SCANNER** — Sandia researcher Mike Sinclair designed and, with the help of Jeri Timlin and Gary Jones, built the Hyperspectral Microarray Scanner for Microarray Analysis to scan glass slides containing DNA. The scanner provides huge amounts of information that is analyzed using Sandia-developed algorithms and software. (Photo by Randy Montoya)

By Chris Burroughs

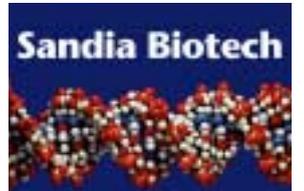
Collaborations between Sandia and the University of New Mexico (UNM) may lead to a greater understanding of genomics and ultimately to new ways to diagnose, treat, and prevent illnesses.

George Davidson (9200) and David Haaland (1812) have been working with UNM researchers on two different projects using several of the same microarray scanning and computing technologies.

One research endeavor — initially funded through an internal Sandia Laboratory Directed Research and Development (LDRD) award and followed by grants from the W.M. Keck Foundation and National Institutes of Health (NIH) — involves Sandia, the UNM Cancer Research and Treatment Center (CRTC), and UNM High Performance Computing Education and Research Center (HPCERC). Using Sandia-developed software and computing capabilities, they are evaluating thousands of genes from some of the 100,000 tissue samples from leukemia patients maintained at the CRTC.

Eventually, higher throughput in these studies will be achieved with new Sandia microarray scanning technology. The goal is to determine pathological gene expressions in these cancer cells. This

*(Continued on page 4)*



## New compound may immobilize AIDS virus and some radionuclides *'Something new and exciting' found serendipitously*

By Neal Singer

A compound that could potentially immobilize the AIDS virus or selectively extract radionuclides from nuclear wastes at various US high-level storage sites has been developed by a Sandia researcher who wasn't even looking for it.

An article in the Aug. 9 *Science* describes characteristics of the newly discovered, extremely active compound, called niobium heteropolyanions (hetero-poly-an-ions) or HPAs.

"It wasn't difficult to synthesize, it was luck," lead researcher May Nyman (6118) says of her discovery. "I wasn't going after it intentionally, but after I found it, I realized I had something new and exciting."

May found the right conditions to synthesize the first niobium HPA, and then tweaked to create an assortment of them.

The entities became the first niobium HPAs ever reported, formed inexpensively at the relatively benign and easily achievable temperature and pressure of boiling water.

Unlike other HPAs, niobium HPAs are basic rather than acidic, which means they can survive longer and possibly even thrive in the generally

*(Continued on page 6)*

*"I wasn't going after it intentionally, but after I found it, I realized I had something new and exciting."*

# Sandia LabNews

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## **For Sandians at the Yucca Mountain Project, 'the real challenge is ahead of us'** **Presidential, congressional approvals mark major milestone for proposed Nevada repository, 35 Sandia project members**

By Will Keener

It's been an interesting year for a contingent of Sandians, hunkered down below the political horizon and working hard on Nevada's Yucca Mountain Project. Although this fight is far from over, Sandia's efforts have earned high marks from a number of sources.

"This is a perfect example of exceptional service in the national interest," says Andrew Orrell, who heads Sandia's Yucca Mountain Project Dept. 6850. "There are not many programs that are singularly reviewed with such scrutiny and directly approved by the President himself and by the Congress."

The process of recommending the site to President Bush from Secretary of Energy Abraham and entertaining a debate in Congress over the issue has taken much of the year. But July 9, the US Senate added its approval to that of the House, voting in favor of proceeding with the project. The congressional joint resolution was signed as expected by President Bush July 23, effectively designating



MINERS COMPLETED this 1.7-mile cross-drift tunnel in October 1998. The tunnel was built for scientific studies near the potential repository area.

the Yucca Mountain site for development as a proposed repository for the nation's spent nuclear fuel and high-level waste.

The action clears the way for the next process — submission of a license application by DOE to the Nuclear Regulatory Commission to obtain

*(Continued on page 5)*

California site's first weapon intern class graduates

3

Seven metro areas benefiting from Sandia security assessments

6



8

ACG 'Thinkfest' provides broad perspective on global future

▶ 12

The opera singer is a physicist — or the physicist is an opera singer

# What's What

Happily, Sandia has been largely spared in the recent spate of publicity about misused government purchasing privileges. Interestingly, while trolling for a list of Staff Augmentation contractors, Charles Shirley (9623) ran across a list cataloging various things Sandia doesn't buy "through its buyers in its Procurement Organization."

Not too surprising, actually, that Procurement buyers don't deal in bail bonds, herbs, or cemetery plots, or with furriers, tailors, health clubs, or undertakers. But refusing to procure amusements, meditation, wineries, tour guides, or party supplies sure leaves us twisting in the wind when it comes to the important stuff.

To see all the other things you can't get Procurement to buy for you, check out the list at [www.sandia.gov/supplier/docs/dontbuy.pdf](http://www.sandia.gov/supplier/docs/dontbuy.pdf).

\* \* \*

Don't collapse from hysterical happiness or hurt your rotator cuff applauding, now, but if you commute to work through the Eubank Gate, construction crews start making your life easier Monday (Aug. 26). Of course, there'll be a little messiness first. Hmmm. . . maybe about three months' worth.

Just keep telling yourself that when it's all over, there'll be more traffic lanes, sidewalks, and a bike lane. The project is scheduled to wind up Dec. 2.

\* \* \*

The note here last time about the guys locating underground utilities near Medical with divining rods caught John Quentin Kirkland's interest. John, who retired in 2000, wrote that he pooh-poohed the "art" until he discovered he could do it himself, and added, "I am not a witch or warlock."

"I have many examples of dowsing's usefulness and it's fun," he wrote. "We had fun with it at Sandia, looking for solder contamination of lab floors for ES&H requirements. It worked!"

One particularly fun dowsing experience, he recalled, happened when he stopped at a Ft. Scott, Kan., historical site during a vacation trip. Watching for a while as site rangers and city workers used their "electronic toys" to find underground wiring, John finally asked: "You want me to dowse the lot for you?" They did, and after he found the electric lines, the lost sewer, and a gas line, "this masked man then rode off into the sunset."

\* \* \*

From the What-Are-We-Called-Now department, an uncharacteristically shy Sandian sent a note with a copy of a shipping label. The note read: "Maybe instead of putting us under the new Homeland Security Department they could assign us to the Department of the Interior."

The destination listed on the shipping label: San Dia National Park.

\* \* \*

Practical jokes - know any really good ones? . . . will disguise names to protect the gullible, but pass 'em along and we'll share.

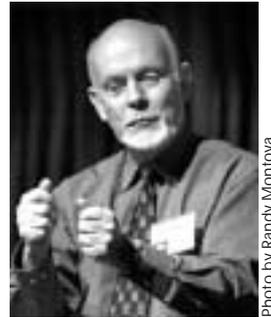
- Howard Kercheval (844-7842, MS 0165, [hckerch@sandia.gov](mailto:hckerch@sandia.gov))

# Nobel laureate Smalley to give Truman Lecture at Sandia Aug. 29

## Discoverer of 'Buckyballs' makes return visit to Labs

Nobel laureate chemist Richard Smalley will give the next Harry S Truman Distinguished Lecture at Sandia, Thursday, Aug. 29.

Smalley, co-recipient of the 1996 Nobel Prize in chemistry for the discovery of carbon atoms bound in the form of a ball - called fullerenes or buckyballs - will speak in the Steve Schiff Auditorium at 9:30 a.m. on "Band-Gap Fluorescence from Individual Single-Walled Carbon Nanotubes." All Sandians are invited.



RICHARD SMALLEY

Photo by Randy Montoya

His lecture will be preceded at 9 a.m. by refreshments in the auditorium lobby and followed at 10:30 by his participation with Sandia President and Labs Director Paul Robinson and Los Alamos National Laboratory Director John Browne in the signing of a Memorandum of Understanding between Sandia and Los Alamos. The MOU defines the two labs' equal partnership in developing and operating the newly announced Center for Integrated Nanotechnologies (CINT, *Lab News*, Aug. 9).

*Richard Smalley*  
Rice University  
Thursday, Aug. 29  
9:30-10:30 a.m.  
Steve Schiff Auditorium

Smalley will participate in CINT as a member of the Governance Board that is charged through the MOU with overseeing the joint laboratory

partnership and successful operation of CINT.

Smalley is the Gene and Norman Hackerman Professor of Chemistry at Rice University and also University Professor at Rice. In addition to his Nobel Prize, he was recipient of DOE's E.O. Lawrence Award in 1992 and of the American Physical Society's Irving Langmuir Prize in Chemical Physics in 1991. He is a member of the National Academy of Sciences.

Smalley will be hosted by CINT Director Terry Michalske (1040).

The Truman Distinguished Lecture Series was established earlier this year (*Lab News*, Feb. 8) to bring the best minds in science, technology, national defense, and social policy to Sandia to speak to and interact with Sandians. The first Truman lecturer, on Feb. 14, was Nobel laureate chemist Alan Heeger (*Lab News*, Feb. 22) and the second, April 1 at Sandia/California, was former Defense Secretary William Perry (*Lab News*, April 5).

## Lab News reader service

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Ken Frazier, Editor . . . . . 505/844-6210  
Bill Murphy, Writer . . . . . 505/845-0845  
Chris Burroughs, Writer . . . . . 505/844-0948  
Randy Montoya, Photographer . . . . . 505/844-5605  
Nancy Garcia, California site contact . . . . . 925/294-2932

Contributors: Janet Carpenter (844-7841), John German (844-5199), Neal Singer (845-7078), Larry Perrine (845-8511), Howard Kercheval (columnist, 844-7842), Will Keener (844-1690), Iris Aboytes (Milepost photos, 844-2282), Rod Geer (844-6601), Mike Lanigan (844-2297), Michelle Fleming (Ads, 844-4902)

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## Recent Patents

- Douglas Bickel and Armin Doerry (both 2344): Error Correction for IFSAR.
- Fernando Bitsie (9124) and Maarten DeBoer (1762): Electrostatic Apparatus for Measurement of Microfracture Strength.
- Bryan Wylie (9227): Method Using a Density Field for Locating Related Items for Data Mining.
- Paul Galambos (1769), Richard Givler (9114), Frank Peter (2614), and Kevin Zavadil (1832): Fluid Ejection Systems and Methods with Secondary Dielectric Fluid.
- Paul Galambos (1769), Richard Givler (9114), Frank Peter (2614), and Kevin Zavadil (1832): Electronic Drive Systems and Methods.
- Paul Galambos (1769), Richard Givler (9114), Frank Peter (2614), and Kevin Zavadil (1832): Ink-Jet Print Head.
- Daniel Aeschliman (ret.), Paul McWhorter (1700), William Miller (5913), M. Steven Rodgers, and Jeffrey Sniegowski (both 1749): Gas-Driven Microturbine.



## Take Note

Retiring and not seen in *Lab News* pictures:  
**Robert Boyden** (10511), 21 years; **Martha Padilla** (10502), 32 years; **Marlene Smith** (2000), 20 years; **Myrna Walla** (10852), 37 years; **Maurice Gauthier** (14186), 31 years; and **Margaret Coy** (10000), 25 years.

# Site's first weapons intern class graduates

**Program aims to ensure there are experienced weaponeers to sustain and advance the stockpile**

By Nancy Garcia

With a successful test flight in June of a Peacekeeper reentry vehicle (RV), six interns culminated their experiences in the first Weapon Intern Program at the California site.

Part of Sandia's Knowledge Management Program, the program was launched in October 1998 to ensure there are experienced weaponeers to sustain and advance the stockpile from research and development through production and support.

"It was a really good opportunity and a good challenge; I think I learned a lot," says Bruce Brunett (8233), who began as lead electrical engineer on the project in October 2000. The Instrumentation Development Flight 3 (IDF-3) vehicle carried subsystems potentially usable in a joint test assembly.

"There was a significant risk of failure," Bruce says, "but we had many things going for us — the experience of two previous IDF designs and the whole support staff in telemetry, drafting, the W87 group, and the test assembly group" (TAG).

The uncertainty and hands-on experience were featured by design when the California site program began. Like the New Mexico version, it also included class time. "It's easy to sit in a class and know the result that's supposed to emerge," Bruce says, "and sometimes, depending on how the class is taught, you can also know the judgment that went into the result. Every system is just a collection of trade-offs."

Developing wisdom born of experience in a new group of Sandians is part of the knowledge

management effort at Sandia that also seeks to preserve the collective judgment of retiring employees who contributed to the existing stockpile. Prior to the California site program, Chrisma Jackson (8215), Jason Bowie (8254), and Robin Gilbert-O'Neil (8727) completed the New Mexico class.

The students are mentored by more senior staff and have the opportunity to speak to retired weaponeers, as well as forming relationships across organizational lines when working on the team project.

"I learned a lot it would have taken me years to pick up just through osmosis, if ever," says Christian Scholz (8221), who was the lead mechanical engineer and project liaison to other agencies — the Air Force, TRW, and Raytheon among them — as well. The group, he says, was well-balanced — half electrical engineers, half mechanical or civil, and evenly split between genders. Besides Bruce and Christian, the graduates are Mike DeVay (8222), Judy Lau (8231), Yuki Ohashi (8727), and Beth Wichman (8222).

Christian found staff in TAG, telemetry, drafting, and the W87 systems group to be very helpful in overcoming hurdles. Christian was concerned that having new parts arrive late in the design process would impact packaging and distribution of mass and weight. Fortunately, all RV problems were resolved in time for the original launch date — unfortunately, the flight date slipped six times due to events beyond the design team's control.

Christian interfaced closely with TRW, the contractor for the reentry vehicle aeroshell, regarding a few modifications that had been made to the external surfaces of the RV.

"In the end, there was some concern whether it would behave exactly as a normal RV," he says, "but no concern it would do anything drastically different." In fact, there was no discernible difference between the IDF-3 performance and that of unaltered RVs.

The missile also flew vehicles by Lockheed Martin and the Department of Defense. A spot on the missile is rare, Bruce says, and current plans call for elimination of multiple reentry vehicles on ICBMs in the future. The group used

up almost the entire internal volume, packing in 12 experiments and 78 cables linked to more than 200 connectors.

Among the multiple experiments in Sandia's vehicle were the first two LIGA parts flown on a test flight (mechanical microsystems fabricated under Sandia direction), various transmitters, and distributed telemetry components. The real-time telemetry aspect was coordinated by Dan Fonte (8222), who described IDF-3 as the perfect project for the first California intern class. Dan's project created a moving map that displayed the reentry vehicle following its predicted path across the Western Test Range and displayed approximately 20 "quick look" telemetry parameters during the 30-minute, 5,500-mile flight on June 3.

Dan, Beth, Christian, and Maulik Shah (8222) operated the real-time telemetry equipment the night of the test flight. Christian was at Kwajalein Atoll in the Marshall Islands where the flight ended; Beth was at a tracking station in Kauai; and Dan and Maulik were monitoring from the Visualization Design Center (relatively near the first of three tracking stations, north of the launch at Vandenberg Air Force Base, at Pillar Point on the California coast). Approximately 25 other Sandians "watched" the flight in the VDC the night of the launch.

"I was worried all the way up until the day I left for Kwajalein," Christian says. The night of the flight, he monitored the test via computer and was on the phone to Beth and Maulik. Waiting for a hold-up to be cleared at Vandenberg, he read a book and watched the screen. "I didn't really think about the fact that it might not work," he remarked. Once the flight took off, "Boring was good — we just kind of watched the data walk along. We got clear, sufficient data all the way out to the end of the flight."

Overall, Bruce adds, the internship "probably exceeded my expectations." He's now working on a larger telemetry project and feels almost right in the middle of the weapons program, where he had hoped for a career since joining Sandia as a summer student five years ago.

## Sandia California News

## Year-to-date Feedback Program report January-June 2002

The Feedback program allows employees to submit questions about the Labs through a neutral party, thus keeping their identity confidential. (See Feedback items on pages 7, 8, and 12 in this issue.) The questions are forwarded to directors or subject-matter experts for a written response. Full information on the Feedback program, the complete Feedback archive and specifics on how to submit a Feedback are available via the Internal web at [www-irn.sandia.gov/newscenter/news-frames.html](http://www-irn.sandia.gov/newscenter/news-frames.html). (Click on the "Feedback" button on the left side of the screen.)

### Key Recurring Questions

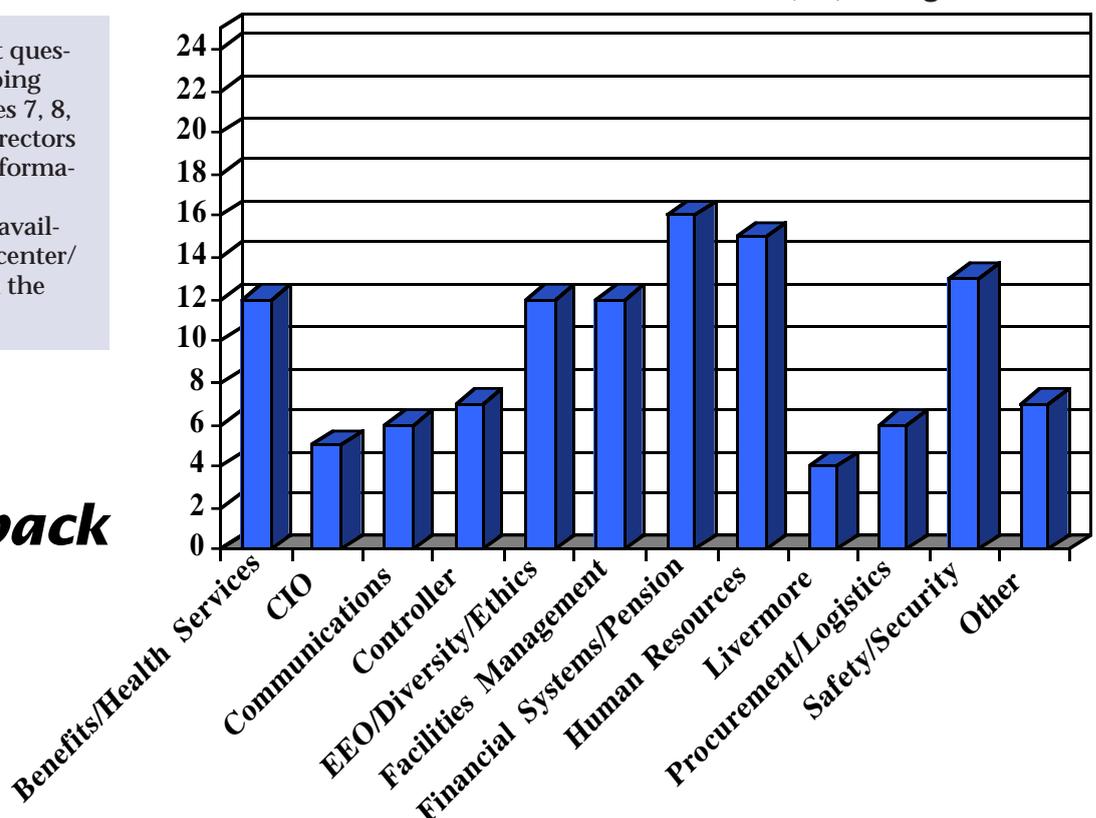
- 401K plan (9)
- Traffic/parking (9)
- Diversity (8)
- SS# ID usage (5)
- Pension plan (5)
- Vacation plan (4)

### Scorecard

- 95 responses completed
- 20 responses in-process
- 41% returned in the 15 day allotted time
- 22 days average response time
- 16 questions have resulted in change or pending change of corporate policy, process, or principle.



115 Questions received YTD in (12) categories



Data compiled by Feedback program administrator Mike Clough (12640)

# Microarray

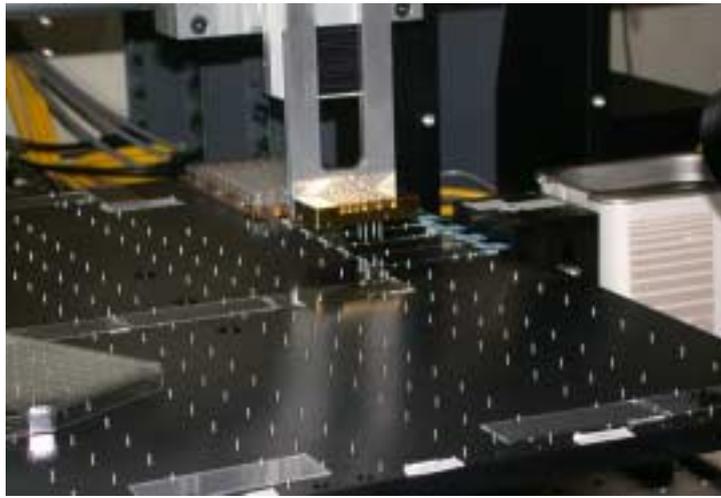
(Continued from page 1)

information will be useful for assigning patients to different treatment protocols and may ultimately lead to the development of drugs specifically targeted to these cancers.

In the other project, Dave and George are collaborating with Maggie Werner-Washburne, a UNM biology professor, to improve microarray analysis techniques and the interpretation of data from microarray experiments. Focusing on yeast cells, the fundamental research is now promising to provide better understanding of how cells transition from a quiescent to a growing state, which is involved in wound responses, cancer, and germination of spores, and the complex response of cells to bioagents. This more applied research is contributing to enhanced instruments and sensors to combat bio-threats.

## Werner-Washburne work

The work with Werner-Washburne came first, emerging from discussions while she was the program director for Microbial Genetics at the National Science Foundation (NSF) in Washington, D.C. She returned to UNM to help create and



THE ARRAYER built by George Davidson and University of New Mexico students is capable of printing 100 glass slides at one time.

lead a group of like-minded researchers interested in exploiting the genomics revolution and helping New Mexico laboratories develop these technologies.

George and Werner-Washburne began developing strong ties between the biology department and Sandia, which included training students and building the required equipment. The work was partially funded by a three-year University Research LDRD grant that began in 1999.

The research had three objectives — the most important being the establishment of viable biotech research collaborations between the two institutions. The second goal was to enable local microarray experiments and to develop the methods and process controls necessary to achieve high-quality results. The third was to research the issues of gene expression of yeast cells in quiescence and during re-entry into the cell cycle.

“The collaborations between Sandia and UNM have been quite successful,” George says. “Importantly, we jointly developed the ability to conduct and analyze microarray experiments using either commercial gene array membranes or arrays printed on glass slides at the UNM Biology Department.”

However, it became apparent that the commercial scanners for reading these arrays could be greatly improved, which led to David Haaland's involvement.

“Maggie and I talked about our research when we would run into each other in our neighborhood park. At the time Maggie was working with microarray technology using two fluorescent dyes to study gene expression of yeast cells, and I was doing hyperspectral imaging in the infrared,” David says. “It became apparent

that the hyperspectral imaging could be useful in Maggie's efforts.”

Werner-Washburne says that the Sandia collaborations started during their walks in the park have been particularly rewarding.

“As a result of our Sandia collaborations, we have been able to take a systems approach to this problem,” she says. “There are very few laboratories in the country that effectively incorporate biologists, computer scientists, chemists, mathematicians, and engineers at this level. It is the future of genomics, and we have a unique opportunity to make important contributions and have fun at the same time.”

## W.M. Keck Foundation

About a year into the Sandia/Werner-Washburne project, the W.M. Keck Foundation of California awarded the UNM Health Sciences Center, which has the largest leukemia tissue repository in the world, and Sandia a \$1 million grant to apply microarray research to leukemia.

George says that the “attractive part of the proposal was the combination of high-performance computing capability and instrumentation technologies at Sandia with the unique tissue repositories at UNM.”

This potent combination is directed toward learning what causes the cancer and which drugs and therapies might be tailored to each individual patient for optimal treatment.

“It is our hope for the future that such studies will allow us to develop specific and more effective therapies targeted to each individual patient,” says Cheryl Willman, CRTC director and principal investigator of the Keck grant.

Of the \$1 million, UNM received 70 percent, and George and David share 30 percent. The CRTC handles all clinical interactions and the laboratory preparations, including scanning the slides with commercial equipment. Those data are then analyzed using new methods developed by George, David, Shawn Martin (9212), and the computer scientists from the HPCERC. David is also developing a powerful hyperspectral imaging scanning device that will greatly improve on the commercial scanner now in use.

VP1000 Al Romig says the collaborative work between UNM and Sandia is an example of a scientific win-win situation.

“Sandia's high throughput methodology, from the microarray scanners to the mathematical tools for data extraction, will have a major impact on a variety of bioscience and technology studies, from basic research of disease to mitigating the biothreat from emergent diseases and ter-

(Continued on next page)

## Hyperspectral imager

Better scanning technology is another product of the University of New Mexico/Sandia collaboration; the result is a new kind of scanner called a hyperspectral imager.

David Haaland (1812) says the researchers found many problems with the existing microarray scanner technology, including a need for greater sensitivity for low-expressed genes and the fact that comparisons between microarray experiments are limited due to poor reproducibility.

“But our main issue was slide fluorescence from impurities,” he says. “The slides had spectral interferences that resulted in extraneous light causing loss of quantitative accuracy.”

David needed a device that would eliminate the influences of the impurities and provide much more accurate data that could be fed into the computers for analysis. He turned to Mike Sinclair (1812), known for co-inventing the Polychromator that uses a combination of optics and microelectromechanical systems (MEMS) to determine gas types.

“David talked to me a long time, wondering if some aspect of the Polychromator could be used to solve this problem,” Mike says. “The answer was no. But I thought I could build a machine that could do the job.”

After analyzing several approaches to array scanning, he developed a design and built the Hyperspectral Microarray Scanner for Microarray Analysis primarily from commercial parts. The scanner he developed is potentially more sensitive than any commercial microarray scanners. Among some of its advantages: considerably greater accuracy and improved rejection of stray light and impurity emission.

Mike started the design of the new scanner in April of last year and by late November he, with the help of Jeri Timlin and Gary Jones (both 1812), had a working device that was providing almost pure data from the slides provided by UNM biology professor Maggie Werner-Washburne and the UNM Cancer Research and Treatment Center.

He can put what appears to be a clean slide with only the DNA samples in the hyperspectral microarray scanner and after illuminating it with one or more lasers, see several impurities in the slide.

“I built this machine, but it is still amazing to use it and see all this information pop out on what looked like a clear glass slide,” Mike says.

The hyperspectral microarray scanner provides Mike and Jeri with huge data files that they put on CDs. David, Jeri, and George Davidson then perform the analysis using Sandia-developed algorithms and software.

The new scanner uses proprietary multivariate software developed in other hyperspectral image analysis projects at Sandia. The result is that they can determine pure-component fluorescence spectra and DNA concentrations in each spot without the use of standards.

Mike will soon be building a second, improved hyperspectral microarray scanner that will be used to study a seaborne bacteria, *Synechococcus*, as part of the recently announced DOE “Genomes to Life” project (*Lab News*, July 26).

## Microarrayer important tool in research

The genome microarray studies rely on two major enabling technologies: the arrays themselves and the scanners that read the information from the arrays. The Keck-funded research uses commercially available arrays from Affymetrix, Inc., but laboratory arrayers give researchers the option to build custom arrays and to work with organisms for which commercial arrays are not yet available.

“One of our first steps was to get access to an arrayer. We ordered the parts and built it over about a week with a group of undergraduates,” says George Davidson (9200). “This was a nice example of the benefits of collaborating with a ‘can-do’ organization like Sandia.”

This initial arrayer has just been replaced with a faster commercial machine, but it served as the main research tool for developing all of the arraying protocols that are now standard in Maggie Werner-Washburne's laboratory at the University of New Mexico. The instrument is a robot, which moves metal pins, first dipping them into reservoirs of DNA, one gene per reservoir, and then tapping the nanoliter quantities onto the surfaces of up to 100 glass slides. Thousands of spots containing different DNA genes are laid out in each array on 100-200 micrometer centers.

After a slide is printed, samples of RNA from the target cells are prepared and translated into DNA complementary to the gene that originally coded the RNA molecule. These cDNA molecules are tagged with a fluorescent marker and incubated above the spots of DNA on the array.

The cDNA find the corresponding gene printed on the array and bind together in a process called competitive hybridization. Interrogation of the array with a fluorescent scanning device measures the concentration of the cDNA (and hence the RNA) corresponding to each gene in the cell.

In a typical DNA microarray experiment, the relative expression levels of all protein-encoding genes are compared between two states of a cell. In this type of experiment, cDNA, derived from RNA taken from the two states (typically a control and an experimental condition), is labeled with two different fluorescent molecules (Cy3 and Cy5). The labeled cDNAs are combined and hybridized to the DNA printed on the microarray. Then the microarray is washed, dried, and read using green and red lasers in a commercial scanner to excite the two fluorophores.

Using specialized computer software, the intensity of the emission peaks of both Cy3 and Cy5 fluorescent-labeled targets in each gene spot are visualized as green and red. The local area around the spot is used to determine the background value, which is typically subtracted for each target. The resulting data are then analyzed with a variety of techniques, including VxInsight, data-mining software developed at Sandia.

Werner-Washburne notes that her research “now has over \$1.5 million in new funding from the National Science Foundation and National Institutes of Health that wouldn't have been possible without the arrayer that George and our students built.”

# Yucca

(Continued from page 1)

construction authorization. The overall process is expected to take several years and will be played out to a background of lawsuits and protests from various interests opposed to the repository, particularly the state of Nevada.

"We were confident that the project would be approved based on the technical arguments, but considering the significant political and legal maneuvering prior to the vote, we couldn't be certain of the outcome," Andrew says of the recent stamp of approval. "It was a significant moment for us and we've tried to emphasize that in our employee recognition efforts. This decision was based on two decades of work and there are literally hundreds of people at Sandia who contributed to it and who should be rightfully proud of the accomplishment."

## The challenge ahead

While morale is high among Sandians on the project, Andrew cautions, "We fully recognize the future environment is going to be stressful. The real challenge is ahead of us with the preparation and defense of the license application. There is a tremendous amount of work ahead."

"Our customers are very demanding and rightly so," says Cliff Howard, acting manager of Repository Test and Analysis Dept. 6855. "They are under a lot of pressure to deliver on schedule high-quality products that can stand up to the scrutiny of oversight groups and critical review organizations."

With its experience base from the Waste Isolation Pilot Project (WIPP) and technical support from matrixed staff in other Labs organizations (including Geosciences Center 6100), Sandia is making a difference in the Nevada project. However, unlike WIPP — where Sandia led the scientific effort — this work is being done under DOE's management and operations contractor, the Bechtel-SAIC Company, supported by participants from several national labs, the US Geological Survey, and commercial contractors.

"We've been very successful in transferring our expertise and experience from WIPP to this project. Sandians are now routinely called upon for discussions regarding successful licensing strategies for technical, managerial, and organizational issues," Andrew says. "It is a great pleasure to know our Sandia staff have this kind of impact on these first-of-kind projects." Sandia was able to directly contribute to a substantial number of key documents used by Secretary Abraham to recommend the site to the President this year, he adds.

For the past two decades, Sandia has assisted in the project's site characterization effort in a number of specific areas including technical management, field and lab-scale testing, data collection, modeling



AERIAL VIEW of Yucca Mountain looking south. Drill rigs at crest were conducting coring research.

*"America's national, energy and homeland security, as well as environmental protection is well-served by siting a single nuclear waste repository at Yucca Mountain. . . . Without Yucca Mountain, the nuclear waste simply stays where it is. However, by moving the process forward, we have the opportunity to dispose of nuclear waste that has piled up at 131 sites in 39 states."*

— Energy Secretary Spencer Abraham

and analysis for both engineered and natural systems, and long-term performance assessment.

Sandia's present workforce on the Yucca Mountain Project includes about 35 technical staff members, 15 support staff, and four managers, distributed between Las Vegas and Albuquerque. Present Labs budget for the project is about \$14 million. Fifteen of the staff and two managers are currently in Las Vegas.

## Key Labs roles

The Las Vegas contingent is co-located with Bechtel-SAIC in Las Vegas, where several Sandia team members hold key management and technical roles in the project organization. Sandia has earned kudos from the managing and operations contractor for its technical contribution, quality practices and performance on cost and schedule.

Cliff's department (6855) is located in Las Vegas and focuses on laboratory and field-testing to supply data needs for Sandia and other project organizations. "Our work in testing always demands innovative engineering," he says of the many first-of-a-kind, high-visibility tests his group conducts.

Albuquerque technical staff do everything from analysis of field test data to interpreting results of million-year simulations of the entire repository system. "The Albuquerque and Las Vegas departments are really seamless and work well as a team, Andrew says. "The majority of our technical effort is accomplished in Albuquerque, while other key

efforts are staffed in Las Vegas."

Hong-Nian Jow's Subsystems Performance Assessment Dept. 6852 in Albuquerque works closely with Cliff's staff and other project participants to take experimental data and build it into process and systems models of the natural and engineered barrier systems. Uncertainties are inherent in estimates and observations from a few years of test data extrapolated to tens of thousands of years in model simulations. Models are often simplifications of vastly more detailed information developed by field and laboratory testing and complex component modeling, explains Hong-Nian. "We need to be able to describe the technical basis for our models, defend their appropriateness and be clear about acknowledging the uncertainty in our results."

Finally, these models are adapted for use in various ways by Peter Swift's Total Systems Performance Assessment Dept. 6851. Developing a scientifically sound analysis of a system as large and complex as Yucca Mountain is a multilayered process, Peter explains.

"Work at each level of the process must meet the highest standards, and must be integrated carefully with the upstream and downstream users within the project."

Peter sees the greatest challenge for his group as "one of communication. Skeptical technical audiences, both within the project and externally, reasonably ask why they should trust our estimates of system-level performance over hundreds of thousands of years. Sound programmatic decisions about the site should be based on a full understanding of our uncertainty about how it will perform. We need to communicate that understanding to a broad range of audiences."

## Thank-you, staff

"We'd like to thank all of the numerous staff who have contributed to the successful site designation for this nation's proposed spent nuclear fuel and high-level waste repository. We especially want to recognize the staff who endured the extraordinary challenges of the past couple of years and who made the site recommendation and subsequent site designation by the President a reality. Congratulations and well-done!"

— Andrew Orrell, Cliff Howard, Hong-Nian Jow, and Peter Swift, Yucca Mountain Project Management Team

# Microarray

(Continued from preceding page)

rorism," Al says. "It's simply another example of Sandia's expertise in physical science, engineering, and computing applied to biological problems. It represents a true scientific win-win. There are problems that are intractable with traditional tools of bioscience, yet attacking them allows Sandia to nurture its own competencies to the benefit of all of our national security problems."

## Contributors

The University of New Mexico and Sandia collaboration involved many researchers.

**From Sandia:** Joy Bemserderfer (1030), Craig Boney (5712), Kevin Boyack (9212), George Davidson (9200), Steve Gentry (5712), David Haaland (1812), Bruce Hendrickson (9215), Nancy Irwin (6531), David Johnson (formerly 9223), Gary Jones (1812), Helen Koller (6531), Shawn Martin (9212), Chuck Meyers (1030), Mike Sinclair (1812), Mark Smith (5712), Justin Spain (9227), Ed Thomas (12323), Jeri Timlin (1812), and Mark Van Benthem, Joyce

Van Berkel, and Brian Wylie (9227).

**From UNM Department of Biology:** Maggie Werner-Washburne, Mary Ann Nelson, Monica Manginell, Juanita Martinez, Jose Weber, Angelina Rodriguez, Gabriel Quinones, Pat Dolan, and Anthony Aragon.

**From UNM Cancer Research and Treatment Center:** Erik Andries, Kerem Ar, Susan Atlas, Bruce Camitta, Myron Chang, Paul Helman, Huining Kang, Marilee Morgan, Mónica Mosquera-Caro, Maurice Murphy, Gavin Pickett, Jeffrey Potter, Fred Schultz, Jonathan Schuster, Irina Smirnova, Bob Verhoff, Cheryl Willman, Yuxian Xu, and Xuefei Wang.

## VxInsight data-mining software used to analyze data

A final step for both the Maggie Werner-Washburne and Keck projects is analyzing, archiving, and annotating the data to determine gene relationships. Many approaches have been taken in these analyses. For instance, researchers from the University of New Mexico are using the high-speed computers at Computing Education and Research Center (HPCERC) to analyze the data with statistical techniques, Bayesian networks, and vector support machines. The Sandia team uses tools from David Haaland's chemometrics research, linear and nonlinear classifiers and vector support machines, and Sandia's VxInsight data-

mining software, which has also been successfully used at other genomic research centers.

"We've used VxInsight for a long time at Sandia for various projects," George Davidson (9200) says. "To make it applicable to genomics, however, the software had to be made even more sophisticated. Some of that development was the direct result of working with Maggie, other parts sprang from our collaboration with Stuart Kim at the Stanford Medical School who uses VxInsight for his genomic research, and many of the recently added capabilities were required to analyze the leukemia data. These same techniques

will be useful in the new Genomes to Life research that has just been awarded."

He believes the Keck project — well into its second of three years — has accomplished much and is the start of bigger things.

"Sandia is poised to begin making major contributions in biology; the researchers in New Mexico and California have a real opportunity now that we have been awarded the Genome to Life grant," George says. "Certainly, the larger Sandia experience and capabilities grew from many sources, but David's and my research benefited from the UNM collaborations."

# New compound

(Continued from page 1)



MAY NYMAN accidentally discovered a compound that could potentially immobilize the AIDS virus or selectively extract radionuclides from nuclear wastes at various US high-level storage sites.

(Photo by Randy Montoya)

basic or neutral environments of radioactive wastes and blood, respectively.

Preliminary work with the Savannah River site indicates that the new compounds do indeed selectively remove certain radionuclides from their waste solutions.

To bind viruses, researchers have tested a host of HPA compositions, says May. "In these exhaustive studies, it's been found that HPAs with small amounts of iron or niobium have an especially strong binding effect. Now we have HPAs that are completely niobium."

HPAs in the form of oxides of vanadium, tungsten, and molybdenum have been known to researchers since the late 19th century. The compounds' peripheries consist of voraciously active oxygen ions. These have long intrigued researchers because of their capabilities to do much useful chemistry, including bind viruses and large metal atoms such as some radionuclides.

Once such compounds bind with an AIDS virus, the virus is no longer capable of entering a cell to damage it. HPAs may also bind with radionuclides called actinides, which removes them from the mixture by phase separation for easier and safer storage.

While previously known HPAs were made cheaply and easily at room temperatures and pressures, they were known to be stable only in acid environments.

This behavior means they cannot function well in blood as antiviral agents, because blood is neither acidic nor basic but instead is neutral.

Even worse, the liquid nuclear wastes at most DOE waste sites — for example, Hanford, Savannah River, and Oak Ridge — are extremely basic. These environments attack acidic compounds and cause them to fall apart, says May.

May's discovery of the base-stable HPA came about when Sandia was called upon by the Savannah River site to find the cause of a clogging problem at the site's attempts to extract a dangerously radioactive isotope of cesium. The extraction called for passing nuclear waste solution through a column of pebble-sized materials called zeolites that sequester cesium into tiny pores. She found that the zeolites contained small amounts of an impurity that forms during manufacturing. The acidic manufacturing treatment of the zeolites led to column-clogging behavior of the impurity. Identifying the problem concluded her task, but scientific curiosity led her to attempt to create the compound as an independent entity.

"I was curious to see if I could synthesize it pure, rather than leave it merely as a discovered impurity," says May.

Her research on developing and utilizing HPAs will be soon be supported by two Laboratory

## Sandia tests new security assessment tool with help from real communities

### Seven metro areas benefiting from Sandia-style security scrutiny

By John German

By this fall Sandia's security experts will be adding to their list of risk-assessment tools a scientific methodology for making entire communities more resistant to terrorism.

The new Community Vulnerability Assessment Methodology (CVAM) will join a family of other Sandia-developed VAMs for government buildings, dams, power transmission systems, chemical plants, and water distribution systems that already have helped plug gaps in the nation's security apparatus.

The VAMs have been created in Security Systems & Technology Center 5800, drawing on expertise gained from Sandia's years as the lead DOE lab for nuclear facility security.

CVAM has been in the works for more than two years, since long before Sept. 11, says project leader Gloria Chavez (5845). The project is funded by the National Institute of Justice's Office of Science and Technology.

CVAM is being developed as part of a Memorandum of Understanding between Sandia and Public Technologies, Inc., a non-profit technology organization of the National League of Cities, the National Association of Counties, and the International City/County Management Association.

#### Training the trainers

Seven metro areas soon will have benefited from the development and testing of the new methodology, says Gloria.

Some two years ago Sandia began collaborating with community leaders in Sterling Heights, Mich., north of Detroit, to begin developing a prototype assessment process. Developmental assessments of Bismarck, N.D., and Dade County (Miami), Fla., followed.

Early this month, Sandia began pilot testing the CVAM prototype in a joint project with Hennepin County, Minn. (the Minneapolis-St. Paul area). More pilot tests are planned for this fall with Tucson, Ariz., Norfolk, Va., and Rochester, N.Y.

By October, says Gloria, Sandia should have CVAM copyrighted.

The Labs likely would license the methodology to security training firms and train their trainers in its use. The security firms, then, would put the tool into the hands of hundreds of communities nationwide via their own train-the-trainer workshops, during which local community leaders and security professionals learn to conduct the vulnerability assessments themselves.

"We use the train-the-trainer method because we don't have the resources to conduct all of the training needed to reach all the interested communities," says Gordon Smith, Manager of Public Safety Technologies Dept. 5845.

#### Identifying targets

The CVAM process requires a community's leaders to first identify 10 to 20 facilities they feel are potential security targets, either because of their symbolic value or because of the possibility of severe conse-

quences if an attack were successful.

Then CVAM takes the leaders, step-by-step, through a scientific risk-assessment process that helps them define threats, analyze consequences, and evaluate the effectiveness of current security measures.

After this risk assessment process is complete, the CVAM user has quantitative risk values for each facility to help prioritize where to spend scarce security funding.

Following this rigorous, consistent process typically reveals security vulnerabilities the community didn't know it had, says Gloria, as well as potential security improvements for known vulnerabilities.

#### Taking expertise to local level

To kick off the Hennepin County pilot assessment, Gloria, Ray Page (5845), Skip Metcalf, and Jimmy Woods (both contractors) ran a five-day workshop in early August for local officials, during which the Sandians provided training on the VAM process and helped the officials prioritize critical facilities.

The Sandia team then conducted assessments of four facilities from Hennepin's list of targets. Local officials participated in the assessments and will conduct assessments on their own of the remaining facilities.

*"It's a tool to improve security before an attack occurs, not a response tool. But how effective it is depends on how thoroughly communities look at their facilities."*

The lists of facilities identified by communities are sensitive, says Gloria, but they typically include medical facilities, financial institutions, tourist attractions, gathering places, corporate offices, infrastructures, hazmat facilities, transportation centers (such as ports or rail yards), and educational institutions.

"This training will bring some of the security expertise available at the national level to bear on public safety issues at the county and city levels," says Hennepin County Department of Corrections Planning Director Fred LaFleur, who also heads the County's readiness group.

#### Consistent analyses

The real value of CVAM, says Gloria, is that it provides a consistent method of analyzing and prioritizing real security risks, identifying which facilities have the greatest threat potentials, and assigning appropriate resources to correcting vulnerabilities.

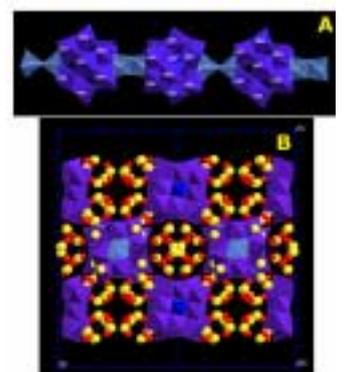
"It's a tool to improve security before an attack occurs, not a response tool," she says. "But how effective it is depends on how thoroughly communities look at their facilities."

Directed Research and Development grants, as well as the Environmental Management Science Project out of the DOE Office of Science in collaboration with the Savannah River site.

"One man's trash is another's treasure," May says of her experience. "What used to be clogging columns could now be taking out radionuclides, so it can be Savannah River's and DOE's treasure in the end, as well."

May's co-authors include Francois Bonhomme and Jim Krumhansl (6118), Todd Alam and Brian Cherry (1811), Mark Rodriguez (1822), Tina Nenoff (6233), and Amy Sattler (former summer intern).

A SECOND PHASE of niobium HPA linked by titanium octahedra. This phase is efficient at extracting radionuclides by ion exchange. Sodium or potassium (yellow) go into solution; radionuclides take their place, binding to the niobium HPA.



# Transparent shielding system designed to stop flying machine debris could protect VIPs, cops, or buildings from rioters, bomb blasts, gunfire

## Newly patented design may find niche in cautious post-9/11 world

By John German

Protecting workers from heavy debris hurtling away from high-speed rotating machinery is usually accomplished with lots of concrete, steel, and soil.

But Keith Snyder of Test Equipment Design Dept. 2955, faced with designing such a "secondary containment system" for a large high-speed centrifuge at Sandia's Weapons Evaluation Test Lab at the Pantex Plant in Amarillo, Texas, and doing it on a limited budget, had a better idea.

Keith combined several commercially available products into a unique shielding system that is far less expensive and quicker to build than the 4-foot-thick concrete walls or underground test facilities normally relied on for machine containment.

Furthermore, the system he designed and patented has post-9/11 security applications beyond the laboratory safety uses he originally envisioned.

### Safety for less

Keith's solution is sheets of polycarbonate (clear plastic, often referred to as Lexan®, a common brand name) glazed into frames made from Unistrut®, commercially available pre-drilled steel bracings that, like pieces of a giant erector set, can



BARRIER around large centrifuge at DOE's Pantex Plant protects workers from flying debris if an accident were to occur, yet allows them to see the machinery.

be combined in a variety of configurations. In industrial settings, Unistrut is used to create overhead tracks for electrical conduit, racks, shelving, stairs, and other structures.

But Unistrut isn't typically used as a barrier. Therein lies the commodity of Keith's idea. His novel combination of struts, polycarbonate sheets, and window glazing presented some intriguing new possibilities.

For machine containment, the impact-resistant transparent sheets provide the advantage of allowing operators to safely see the machinery behind the barrier during operation, says Keith, who studied several glazing and Unistrut bracing configurations to make sure the barrier could contain whatever was flung at it by the machine.

In particular, a series of projectile impact tests conducted at the Southwest Research Institute (San Antonio, Tex.) examined how load is transferred and absorbed by the polycarbonate and bracing system when the barrier is struck by flying objects in the worst-case centrifuge mishaps.

The first such barrier was installed around the Pantex centrifuge about two years ago, after Keith made the case that it was a viable alternative to



SAFETY AND SECURITY — An inexpensive barrier system designed and patented by Keith Snyder (sheets of impact-resistant clear plastic glazed into Unistrut framing) has post-9/11 security applications beyond the laboratory safety uses Keith originally envisioned. (Photo by Randy Montoya)

constructing a \$300,000 concrete bunker around the centrifuge to stop any flying debris that escapes from the machine's "primary containment" (the safety shielding built into the centrifuge) — or stop the centrifuge itself — in a serious accident.

"We built the first barrier in four days for about \$30,000," he says.

### Crowd control, VIP protection

Sept. 11 gave Keith some ideas about the braced Lexan for security applications.

Three-quarter-inch-thick Lexan is rated as bullet-proof against small arms fire, he says, so the Unistrut/polycarbonate combo would make good guard booths, for instance.

He also envisions see-through, modular, easy-to-install barriers for public gatherings to shield people from bomb blast shrapnel, protection for important functionaries who might be targets of assassins or terrorist small-arms fire during public appearances, and crowd-control walls to keep police safe and separate from rioting mobs.

More testing needs to be conducted to prove the validity of the barrier system for some security applications, he says. In particular, little data exists regarding lower-velocity impacts, such as from grenade shrapnel or objects hurled in riot situations.

Sandia recently received a US patent on the modular shield system for both machine-containment and security applications. Keith says he'd be interested in sharing the shield design and performing testing to release this system for public use, should the need arise.

More about the project is available at [http://www.sandia.gov/security/Security\\_Barrier](http://www.sandia.gov/security/Security_Barrier).

## Feedback

### Video streaming coming to your desktop

**Q:** Today, I read about the new Sandia video newsmagazine "Impact." It sounds like another great way to communicate what's going on at Sandia. But unfortunately, I doubt if anyone in our organization will ever see it. We never get to see the LM1 videos that Lockheed Martin puts out either. It's been years since I've seen one. We have team meetings sporadically, but these are never presented. I suspect this is the rule, rather than the exception at the Labs. It seems there are few Sandia TV monitors around the Labs to view them. Also, if you are interested in viewing them, you need to know the schedule.

The importance of good communication is stressed on the job. But each one of us represents the Labs to the public outside of work. If we all are informed about what the lab does, we can all be better ambassadors. Those of us who read the Sandia Lab News, the Sandia Daily News, and Lockheed Martin Today can keep up with most of what's going on within the corporation. But many folks prefer to watch a video clip rather than take the time to read an article. Eventually, will these videos be available on our desktop through video streaming?

**A:** Yes! An integrated effort has been underway to investigate the latest video streaming technologies, make a recommendation for a video

streaming solution that can be deployed Labs-wide, and implement the solution. The team consists of members from Video Services, WebOps, Tech-Dev, Networking, and Education and Training. We are also coordinating with the Knowledge Preservation project. There are team members from both California and New Mexico. The video streaming system will be called Sandia VU, which stands for "Sandia Video to You." The Video Services Department will provide the content for Sandia VU. "Impact" and "LM1" videos will definitely be available for you to view at your convenience at your own desktop, as will other programs of interest. Your question is very timely as Aug. 29 is the date we kick off the Labs-wide implementation. You might want to attend the one-hour info session on Aug. 29 at 2 p.m. in the Steve Schiff Auditorium (it will be video conferenced to California at 1 p.m. PST). It will tell you how to access the video streams and give you a chance to ask any other questions you may have. Prior to the 29th if you would like to see "Impact" at your desk you can stream it from the Video Services homepage at the following address: [www.irn.sandia.gov/organization/div12000/ctr12610.html](http://www.irn.sandia.gov/organization/div12000/ctr12610.html). — Judy Hubbard (12610)

# ACG 'Thinkfest' provides broad future perspective

**Advanced Concepts Group-sponsored conference examines long-range global, national problems**

By Neal Singer

A two-day "Thinkfest" organized by Sandia's Advanced Concepts Group (ACG) (16000) attracted participants from a wide range of organizations external to the Laboratories as well as from Sandia.

The intent was to examine old concepts about global and national security, discard those waning in relevance, and develop new general areas of concentration, in order to focus attention on what VP and Chief Scientist Gerry Yonas calls "the next big thing."

Warned one participant, "The rest of the world increasingly sees the United States as living by this motto: 'We deserve everything we get and if we don't get it, somebody's going to have to pay.'"

The ACG works to identify and propose solution frameworks for perceptual and physical risks that might occupy national agendas in a 10- to 20-year time frame. It seeks to derive system solutions within economic and political constraints, identify science or technology advances that might mitigate anticipated problems, and look for contributions that Sandians might make.

According to a flyer describing the conference, "National and global security issues stem from trends and events apparent through. . . the following four perspectives: nations and their interactions. . . people and their institutions. . . the Earth and its resources. . . [and] technology and its applications. . ."

Among the group's conclusions:

- American and European "Winner Take All"



A WHITE BOARD FULL OF IDEAS — Participants in the recent 'Thinkfest' sponsored by Sandia's Advanced Concepts Group keep track of a complex suite of interrelated global issues via a tried-and-true method: the whiteboard.

behavior with profound Western wealth and technological competency — monopolized by a very small percentage of the global population — will prompt explosive innovation in ideological threats to American and European dominance. Broad instability and global confusion will ensue.

- Major climate changes could cause 'the Mother of all market failures,' with a presumably huge downside risk; international institutions are not structured to deal with either the problem or its fallout.

- Because there's "no end to the damage that could be done," the US public might be persuaded that [more pervasive] British-style cameras, ID

cards, etc. are needed.

- Utility grids are vulnerable to disruption. Can new technologies in wireless communications, generators, and batteries serve as the basis of a less vulnerable infrastructure?

- Stresses posed by population trends are certain; economics and national security merge; they cannot be merely compartmentalized and dealt with separately. Military capabilities must be realigned to match economic, population, and ideological threats.

- First-strike arsenals risk systemic spillover/chain reactions.

- Methods are needed to reverse the growing trend toward fundamentalist extremism in many Arab countries.

- The pervasive nature of biological sciences causes many of the emerging opportunities and problems related to nations and their people. Biotechnology advances may cause demographic problems, as well as dangerous macro organisms and deadly pathogens. On the other

hand, these innovations may have a tremendously positive effect on agriculture and offer huge solution spaces for other problems.

Participants came from the CIA, the Washington-based Center for Strategic International Studies, the New America Foundation, and the Potomac Institute, in addition to Los Alamos National Laboratory, DOE-AL, and Sandia.

For a more complete summary of the views expressed at Thinkfest, please visit the ACG website <http://www-irn.sandia.gov/organization/div16000/div16000.html>, and click on "Workshops."

## Machinist intern Sharon Gordon wins big with SkillsUSA

Sharon Gordon (14186), a new student intern in the "Shops" (Manufacturing Enterprise Depts. 14181 and 14186) who switched careers to machinist after being a nurse for 18 years, has already shown she's a winner at the Labs.

In June, after working at Sandia for two months, she received the \$5,000 Paul Pentz True Leader Scholarship Award during the annual SkillsUSA competition. Paul Pentz is the former CEO of True Hardware and is involved in the selection of the scholarship winner.

Sharon, a TVI student who expects to earn her associate degree in metals technology with a con-

centration in machining next April, received the award in front of all the people participating in this year's national competition.

"I was impressed and flattered to receive the award, especially in an arena filled with over 12,000 participants," Sharon says.

Skills USA is a national organization with 266,000 high school and college student members and their chapter advisors who serve as professional members. All are involved in training programs in technical, skilled, and service occupations, including health occupations.

Organization members participate in annual competitions that test their technical and leadership skills. Initial competitions are at the school. The top winners of the school competitions go on to compete at the state level. Then the top winners of the state level compete at the national level.

Sharon learned about SkillsUSA after returning to school in 2000 to study welding. After nursing for 18 years, she decided it was time to do something different.

Her interest in metals was peaked when her son, now 14, wanted a go-cart. She started taking classes in welding at TVI. Along the way she became interested in being a machinist and entered the TVI program.

She immediately joined the TVI chapter of SkillsUSA and soon became president of that



"SHOPS" STUDENT INTERN Sharon Gordon received the \$5,000 Paul Pentz True Leader Scholarship Award during the annual SkillsUSA competition. The awards program was started by Paul Pentz, former CEO of True Value hardware stores.

chapter and of the state SkillsUSA organization. She's gone to the national SkillsUSA competition twice.

Also after enrolling at TVI she learned about Sandia's student intern program and applied for that, coming to the Labs in April.

Sharon hopes to be at Sandia a long time. She's already been tapped to participate in the Labs' trades apprentice program after she obtains her associate degree. Also, she plans on continuing school to obtain her BS and MS degrees — the \$5,000 scholarship will be helpful there.

Paul McKey, Manager of Manufacturing Processes and Services Dept. 14186, says Sharon brings "lots of energy, excitement, and new ideas to our organization. She is very eager to learn new things." — Chris Burroughs

### Feedback

#### Reader says Tech Area gates 'embarrassing'

**Q:** Why are the pedestrian gate areas around Tech Area 1 so dirty? I have noticed that since the guards have been replaced with the badge readers and turnstiles that there has been an increase of spilled drinks and in some cases whole breakfasts and lunches around and in the turnstile areas.

**This is not only disgusting, but also very embarrassing when escorting visitors and new hires into the area. Can't a regular schedule be set up where the areas can be washed down?**

**A:** Our Ground Services Department is currently inputting into our work control system preventive-maintenance work orders to clean these areas weekly. In addition, these areas will be placed on a quarterly schedule to be power washed four times a year. This process [started] in early June. In the interim, Grounds Maintenance generated work requests to have these gates cleaned through the Telecon + process. In the event there is a food or drink spill, please call Telecon + at 844-4571 or try our new web-based Facilities e-Services and we will respond to your request. — David Corbett (10800)

# Sandia workshop draws top theoretical thinkers in bid to improve understanding of materials behavior

## Nobel laureate Walter Kohn, father of density functional theory, speaks at Labs-sponsored event

By Bill Murphy

In understanding the structure and properties of solids and molecules and their chemical reactivity at the most basic level, sometimes less is more and more is less.

That insight lies at the heart of quantum-level Density Functional Theory (DFT), for which Prof. Walter Kohn of UC/Santa Barbara shared the 1998 Nobel Prize in chemistry (see "Kohn's insight" below). Conventional calculation of the properties of solids and molecules is based on a simultaneous description of the collective behavior of all electrons in the molecule or unit cell of a solid. Such methods are mathematically very complicated and become intractable even for a modest number of atoms. Kohn showed that it is not necessary to consider the detailed collective behavior of all the electrons: it suffices to know the average number of electrons located at each point in space.

Now, DFT — which in many cases offers a practical research alternative to the proven, but often unwieldy, Schrödinger equation in describing the properties of materials — is assuming a key role in, for instance, developing better materials descriptions in computational-based modeling and simulation, an area in which Sandia has obvious and urgent interest.

Kohn, as the father and leading light of the field, was the honored guest and first speaker at a Sandia-sponsored workshop last week in Albuquerque to explore new avenues in DFT. Other speakers and presenters at the workshop constituted a who's who of the international DFT community. Sandian Ann Mattsson (1114), who did postdoctoral work with Kohn on DFT, organized the workshop and presented, with colleagues, two papers to the proceedings.

Sandia VP Al Romig, whose Physical and Chemical Sciences Center 1100 co-sponsored the workshop, noted that "something as focused and collegial as this [workshop] is really quite special; it's really a way to let us get at some fundamental problems we can grapple with . . . It's a wonderful way to advance the state-of-the-art."

Al noted that to fulfill its mission, Sandia must invest substantially in a science and technology underpinning. DFT, he said, is a valuable — and likely to be an increasingly valuable — tool in helping the Labs advance the state of knowledge in areas of computationally enabled nanosystems, high-energy physics, and materials



NOBEL LAUREATE WALTER KOHN and Ann Mattsson (1114), organizer of a Sandia-sponsored workshop on density functional theory, discuss Kohn's latest ideas on the subject for which he won the 1998 Nobel Prize in chemistry.

science. As such, he said, "We thought that getting people [of your expertise] together would provide us a real opportunity to get some cross-fertilization, to solve problems and discuss important issues in the field."

### Solving real problems

Al offered a personal anecdote about his early experiences in modeling and simulation at Sandia in the early- to mid-1980s. Although his team succeeded in their efforts, Al says he would have loved to have DFT-based tools available at the time for the challenges he worked on.

"It's exciting," he said, "to see that the theory [DFT] has progressed to the point where it's being used to solve real problems."

Senior VP Tom Hunter — his division includes the Computer Science Research Institute (CSRI), the other cosponsor of the workshop — noted that the Labs has "an awesome responsibility" to certify the safety, security, and reliability of the nation's nuclear weapons. As such, he said, there is a profound sense of obligation for Sandia management to "invest in understanding at the fundamental level and the application level." That sense

alone would justify the Labs' interest in further refinement and advancement of DFT. But the Labs' interest goes further: "We want to be leaders in the revolution in engineering," Tom said. And that means a heavy reliance on advanced modeling and simulation, and thus on tools — such as DFT — that make modeling and simulation more effective.

Tom cited a well-known quote variously attributed to Yogi Berra, Casey Stengel, Freeman Dyson, and even Niels Bohr: "Making predictions is hard — especially about the future." To emphasize the remaining challenge, Tom advanced the corollary, "Simulation is hard, especially when it is dealing with reality."

Tom offered a long list of issues for which more effective modeling and simulation would be indispensable:

"We worry about a lot of things. Like, how do things age? Materials and desiccants; chemical reactions and their influence on corrosion; response to adverse environments.

"We worry about radiation effects, all the way from global effects to single-point events in silicon in integrated circuits. And we worry about very small devices. Sandia's largest investment for the future is about small, smart things — and they don't always lend themselves to macroscopic understanding. So we have to worry about how small machines work, and particularly about how integrated systems work that combine optical systems, chemical sensors, processors, and tiny machines. We care about those things; and we intend to invest in [gaining an understanding of] those things."

At the core of all these concerns, Tom said, is an underpinning of quantum mechanics.

"So now," he said, "the challenge is to explore what knowledge we have and ask how it can open up new frontiers for us in better understanding materials and their interactions."

## Kohn's insight

(Adapted from the official 1998 Nobel Prize press release announcing that Walter Kohn and John Pople would share the Chemistry prize for their related, but autonomous work in quantum chemistry.)

The laws of quantum mechanics as formulated more than 70 years ago make it theoretically possible to understand and calculate how electrons and atomic nuclei interact to build up matter in all its forms. The task of quantum chemistry is to exploit this knowledge to describe the molecular system. This has proved easier said than done. It was not until the beginning of the 1960s that development really started, when two events became decisive. One was the development of an entirely new theory for describing the spatial distribution of electrons. . . . **Walter Kohn** showed in 1964 that the total energy for a system described by the laws of quantum mechanics can be theoretically calculated if the electrons' spatial distribution (electron density) is known. The question is only how the energy depends on the density. Kohn gave important clues based on what this dependence looked like in an imaginary system with free electrons. It was to take several decades and contributions from many researchers, however, before the equation for determining the energy was sufficiently accurately mapped to permit large-scale studies of molecular systems. This has taken place partly through the adaptation of a small number of variables to experimental data. The method Kohn introduced came to be known as the density-functional theory. It is now used in studies of numerous chemical and material problem areas, from calculating the geometrical structure and properties of solids and molecules to mapping chemical reactions.

## Sen. Bingaman views homeland security work



SEN. JEFF BINGAMAN, D-N.M., asks Ruth Boyd (12345) about details of the Weapon Recovery Decision Support System, a tool used by DOE's Accident Response Group. Bingaman visited the Labs' new International Programs Building earlier this month to receive briefings and demonstrations of Sandia-developed technologies with homeland security applications. During the visit, Bingaman discussed with local news media his views on the proposed Homeland Security Department and about the roles the national labs may play in counterterrorism efforts. (Photo by Randy Montoya)

# Management promotions

As a result of numerous requests, beginning with this issue the Lab News plans to publish notices of monthly promotions to the management ladder and within the management ladder. Thanks to HR Information Systems Dept. 3051 for making the official information available to us as a starting point. The biographical information is supplied to us by the employee. These are the Sandians receiving such promotions in May. Those for June, July, and August will follow.

## New Mexico



RICHARD ANTEPENKO

**Richard Antepencko**, from Team Leader in Production Staging Dept. 14405 to Manager of Analytical & Tritium Technologies Dept. 14406. Rich started work in August 1973 at the GE Neutron Devices Department, a DOE production plant, in Largo, Fla. He transferred to Sandia/New Mexico in June 1994, when the production mission for neutron generators came to Sandia. Rich is an analytical chemist, specializing in instrumental and wet-chemical methods of analysis. His new duties are managing a laboratory program that supports the production and design of neutron tubes and neutron generators. Rich has a BA in chemistry and an MS in analytical chemistry.



DONNIE GREENE

**Donnie Greene**, from Central Alarm System Operator to Team Lieutenant in Protective Force Dept. 3114. Don has been a member of Sandia's Protective Force since he joined Sandia in March 1991. He has a BS in public administration from the University of Arizona.



RICHARD CERNOSEK

**Richard Cernosek**, from PMTS in Microsensors S&T Dept. 1744 to Manager of Micro-Total-Analytical Systems Dept. 1764. Richard has worked in microsensor technologies since joining Sandia in 1977. He earned a BS and an MS in physics from Texas A&M University-Commerce before coming to Sandia, and then earned his PhD in electrical engineering from the University of New Mexico through Sandia's Educational Aids Program.



VIRGINIA CLARK

**Virginia Clark**, from DMLS in Alignment and Integration Office Dept. 9902 to Manager of Div. 5000 Business Operations Dept. 5005. Ginny joined Sandia's Benefit Systems and Health Care Dept. 3545 in March 1987. For the past nine years, she's worked in program/project management at the Labs. She has a BS in dietetics from the University of Wyoming and a BA in accounting and an MBA in finance from the University of New Mexico.



SCOTT MITCHELL

**Scott Mitchell**, from PMTS in Parallel Computing Sciences Dept. 9226 to Manager of Optimization & Uncertainty Estimation Dept. 9211. Scott came to Sandia in November 1992. Dept. 9211 is responsible for software and methods for understanding and improving the performance and variability of designs. Scott has a BS in applied math, engineering, and physics from the University of Wisconsin-Madison, and an MS and a PhD in applied math from Cornell University.

**Mark Daniel (Danny) Rintoul**, from PMTS to Manager of Computational Biology in Dept. 9212. Danny has worked on many different aspects of algorithm design for computational science since he joined Sandia in July 1997 as a member of Computational Material Science Dept. 9225. He has a BS in physics from Caltech and a PhD in computational statistical physics from Purdue.



DANNY RINTOUL

**Joseph Roesch**, from Manager to Level II Manager of Transportation Safeguards and Surety Programs Dept. 5850. Joe has worked in transportation security systems engineering for the last 15 years. He has been involved in security systems for the protection of nuclear weapons and/or special nuclear material since joining Sandia in January 1977. Joe has a BS and an MS in mechanical engineering from the University of New Mexico.



JOSEPH ROESCH

## California

**Steve Carpenter**, from PMTS in Distributed Information Systems Center 8900's DISL Program Dept. 8904 to Manager of Applications and Systems Integration Dept. 8945-1. Steve joined Sandia/California's Facilities Management Department in October 1983. He has worked in project and program management at the Labs since then. Steve has a BS and an MS in civil engineering.



STEVE CARPENTER

## Dear Energy Nag:

**Dear Nag:** You've been telling us to turn off lights in the hallways and bathrooms, but what difference does that make? It's dark enough over here having to live without sunlight and watching fungus grow under my fingernails. — *Turning Sallow on the Dark Side (the windowless side of Bldg. 810)*

**The Nag:** There are 40 light fixtures in your hallway, each with two 40-watt lights. So suppose you turn off the hallway lights on your floor when you make one of your dozen trips to the well-lighted bathroom each day, and suppose some miscreant doesn't come along and turn the lights back on for a while. Suddenly 3,200 watts (3.2 kilowatts) of power is no longer consumed. If that happens on three floors, that's about 10 kilowatts, and roughly 20 pounds of CO<sub>2</sub> not dumped into the air every hour, and just from one building at one obscure national lab. Amazing!

\*\*\*

**Dear Nag:** Yesterday my wife threatened to divorce me as I was changing out all the light bulbs at home with compact fluorescents. She can't believe I didn't even wait for the old ones to burn out. — *Well Meaning on the West Side*

**The Nag:** The Nag is well aware of the divorce-threatening that occurs when lights are changed. (Just what IS it with women and compact fluorescent bulbs? They hate them.) The

Nag recommends that you do what he has done with his wife, which is to threaten to walk around in underwear (only) unless she agrees to simple, prudent, environmentally responsible energy behavior.

\*\*\*

**Dear Nag:** On TV commercials, they show you how detergents take out bloodstains. I think if you've got a T-shirt with bloodstains all over it, maybe your laundry isn't your biggest problem. What do you think? — *Low Temp-a-Cheer*

**The Nag:** The Nag agrees. On the other hand, if said launderer is using cold water instead of hot water to wash his or her clothes, and saving energy in the process, he/she has some redeeming social value despite grinding his/her spouse in the wood chipper.



THE ENERGY NAG

## Saving energy at home, too

The average New Mexico house uses 700 kW-hours per month. The Energy Nag's house uses 150 kW-hours per month. The difference is roughly 3.5 tons of CO<sub>2</sub> not pumped into the air, 7,000 gallons of water not used for cooling at the generating station, and about \$600 per year in power bills, says The Nag.

Here are some things you can do to get your home power consumption down.

- Replace some bulbs with fluorescent ones or halogen fixtures.
- Turn up the temperature in your freezer so you don't freeze things beyond the sufficient state of "frozen."
- Clean your refrigerator coils once a season.
- Turn off your swamp cooler or air conditioner when you're not in the house (and during the hottest part of the day when they don't do much good).
- Change your swamp cooler pads and heater filters periodically
- Look for vampire loads such as clocks, TVs, radios, answering machines, portable phones, etc. and physically unplug them if you aren't using them or don't need them in the first place.
- Dry your clothes outside. Your clothes will last much longer. [Note: The Nag still has some of his clothes from 1972.]
- Make sure you have good windows and, if possible, good insulation.

# Sandia Classified Ads Sandia Classified Ads Sandia Classified Ads Sandia Classified Ads

## MISCELLANEOUS

COMPUTER, complete outfit, 486, w/math coprocessor, CD, hard drives, floppy, tape backup, everything works, \$50 OBO. Andersen, 286-1751.

TWIN BED, mattress, box spring, frame, blue metal headboard, \$80; light oak dresser, \$40, both excellent condition. Rightley, 293-9780.

STUDENT DESKS, 2, w/matching chairs, good condition, \$50 ea. Webb, 828-2271.

CENTURY CAR SEAT, \$50: Little Tykes car, \$20, and kitchen, \$25; Kelly Ridgeway child carrier, \$40. Kerekes, 281-2153.

HAIR DRYER, Remington ProAir, 3-heat, 2-spd., new, \$14; 22-pc. highway emergency tool kit, new, \$8. Smith, 256-0712.

DASH COVER, gray, '98-'02 Blazer, Jimmy, Bravada, \$15; timeshare, Hawaii, \$750/wk. Varoz, 831-6093.

DELL COMPUTER, 700-MHz, 17-in. screen, CD burner, color printer, speakers, hardly used, \$700 OBO. Sanchez, 720-9078.

MUSIC EQUIPMENT: Crown PB2, 800W, \$500; Fender bass, \$75; Fender amp, \$50; portable rack case, \$75; strapless guitar stand, \$65. Adams, 281-6767.

TENNIS TABLE, butterfly rollaway, w/4-player set, \$150; stationary exercise, for upper & lower body, \$125. Pike, 299-6153.

LOFT BEDS (3), \$50 ea.; ping-pong table, \$60; microwave, \$10; '84 Prelude, \$300. Hartshorne, 884-4887.

NEC PENTIUM, 50-MHz, 40MB RAM, 2GB hard drive, CD, floppy, Zip, Windows 98, tower, \$50 OBO. Georg, 281-2480.

CLARINET, Selmer, w/stand, great shape, ideal for student, \$225. Gordon, 292-7728.

PANASONIC DVD SYSTEM, 5-DVD changer, Dolby digital decoder, 5-speaker surround, AM/FM/tape, \$275 OBO. Gonzales, 660-3281.

TIRES, 2, P205-65R15, Michelin MX-4, good tread, \$15 ea. Moore, 296-6586.

HARRY POTTER CDs, "Chamber of Secrets," 8 discs, perfect condition, great for kids, \$25. Schalip, 296-4006.

SOFA & LOVESEAT, cream/rust, \$80; cherry coffee table, \$60; hutch, \$35; antique chair, needs cloth, \$80. Rechar, 292-1754.

JVC TV, 27-in., purchased 6/9/02, multiple audio/video inputs, \$250; entertainment center, audio, video, tape compartments, \$35. Hale, 298-1545.

RIDING LAWN MOWER, 13.5-hp, \$850; George Foreman rotisserie, \$75; Ab/back exercising machine, \$50; Tae Bo tapes, \$5 ea. Perez-Romo, 255-6246.

MICROWAVE, large GE, in great condition, works wonderfully, will accept reasonable offer. Richardson, 463-0829.

DRESSER, w/attached hutch, chest of drawers, nightstand, \$225; 4-poster twin bed, w/mattresses, \$125. Franks, 286-0522.

LAWN MOWER, Toro, gas, bag/mulch, excellent condition, sold house, no more yard, \$75. Rullman, 797-2976.

MULTI-FAMILY GARAGE SALE, Aug. 23-24, 9215 Meriwether NE, northeast of Ventura & San Francisco. Williams, 797-8912.

GOLF CLUBS, Ben Hogan Apex Edge Pro, irons, 3-PW men's, brand new, \$749.99 at Oshman's, asking \$600. Chavez, 220-4971.

PIANO, Betsy Ross, \$600, you haul. Solanos, 298-4523.

TIRES, 4, P215/75R15, 80% tread, on Ford 5-hole factory rims, w/wheel covers, \$100 or \$30 ea. Penn, 883-4195.

SOFA & MATCHING LOVE SEAT, gray/blue/cream patterned upholstery, used but great for college student or multi-purpose room, \$75. Burgess, 286-0606.

DESK, wood, nice, \$100; mountain bike, excellent, \$325; circular futon, \$50; CD rack, wood, large, \$50. Campbell, 281-0744.

GAS DRYER, Kenmore, almond, 13 yrs. old, good condition, \$85. Lewis, 884-1761.

FRONT GRILL, for '99 Infiniti QX4, black, \$425. Moreno, 294-4268.

TRUCK STEPS, Lund runners, extra cab, never installed, receipt & warranty, \$80. Fisk, 323-2359.

PENTAX SPOTMATIC II CAMERA, 3 lenses, other accessories, \$240; American Harvest dehydrator, 6 trays, \$40; StarTAC cellular charger, \$50. Pitts, 293-5481.

TRUMPET, Bach, gold, w/hard/soft cases, mute, cleaning kit, & flip folder, excellent condition, \$400. Thayer, 296-9566.

PIANO, Baldwin Acrosonic, bench included, \$750. Navratil, 293-5527.

MOTORCYCLE TOURING JACKET, women's, medium, red/black, FirstGear Kilimanjaro H-T jacket, never used, new \$340, asking \$200. LaPorte, 275-2067.

PROFESSIONAL DRAFTING TABLE, \$125; oak entertainment center, \$50; brass headboard, king-size, good condition, \$45. Owen, 332-8294.

SOUTHWEST AIRLINE TICKETS, 2, good through March 03 & May 03, \$300 ea. or \$575 both, cash only. Schroen, 286-1428.

LOBO FOOTBALL TICKETS, 4, on 47-yard line, mid-level west stands, face value. Hartley, 292-7437.

B/W LONGBED CAMPER SHELL, excellent condition, \$150 OBO; oval dark-wood dining table, carved legs, 5' x 46", \$50. Crosby, 260-1070.

TELEVIDEO COMPUTER, Microterm monitor, electric typewriter, 30 chain-link fence posts, gate, hardware, all free. Shaw, 856-1141.

WASHER/GAS DRYER, Maytag, runs & looks like new, excellent condition, \$400 both OBO. Veltkamp, 271-0325.

LOVE SEAT, \$100; La-Z-Boy recliner, cream color, \$75; dining room table, 2 leaves, 4 chairs, \$300 OBO; entertainment center, \$200 OBO. Gallegos, 804-3758.

PLAYSTATION 2 GAME, "Grand Theft Auto III," new condition, was \$50, asking, \$30 OBO. Mooney, 294-5161.

COCKATIEL, standard gray, hand-raised, baby, \$50; birdcages: unit, 9 breeding cages, 2 flight areas, \$100; 2 cages, \$20 ea. Rhodes, 899-5444.

GOLF CLUBS, Callaway, "96," B.B. irons, 3-LW, \$375; Warbird, 3&8s wood, \$95 ea. Gutierrez, 898-2406.

DINING ROOM SET, dark wood, colonial style, includes hutch, table & 6 chairs, \$850. Mahn, 823-4796.

GARAGE SALE, Aug. 23-24, 9-12, 2811 Ridgecrest Dr. SE, 28 years worth of treasures, no early birds. Barnard, 256-7772.

FLUTE, Emerson, w/extra rounded head for younger students, excellent condition, \$500. Meyer, 856-9649.

TAPPAN GAS RANGE, upper & lower oven, w/exhaust fan, excellent condition, \$200 OBO. Baca, 877-6490.

COMPAQ PRESARIO 4508, scanner, monitor, & printer. Bangs, 299-6677.

YAMAHA FLUTE, new pads, \$400; Pearl practice drum set, solid & mesh heads, extras, \$400. Fugelson, 323-6037.

METAL SHED FLOOR KIT, galvanized steel, framing kit for 10x9, 10x8 or 8x8 storage shed, complete w/instructions, paid \$77, asking \$35. Reuter, 884-8347.

VACATION, Acapulco, Thanksgiving week, 11/23-11/30, Mayan Palace, 2 adults, beachfront, pool, restaurants on-site, \$600. Wilsey, 237-8614, www.mayan-palace.com.

BOOM BOX, w/2 12-in. Kenwood subwoofers, & Sony amplifier, sounds great, \$250 OBO. Barela, 877-9535.

ANTIQUE SPINDLE CHAIRS, 5, oak, need refinishing, \$100 ea.; antique butter churns, 4, various prices. Fisher, 293-2864.

COMPUTER, 100-MHz, 48MB RAM, 2GB, SB16, 36x CD, 15-in. monitor, Canon BJC5000 printer, Zip-100, floppy, speakers, \$475. Oishi, 293-9478.

SOUTHWEST AIRLINE TICKETS, expire 10/5/02, \$280; expires 7/30/03, \$310; MustRide passes (no restrictions/fees), expire 3/31/03, \$325. Lieberman, 299-7739.

SLIDE PROJECTOR, Kodak Carousel 750H, w/19 slide (140) trays, \$150. Dell, 291-0274.

HOT TUB, 7x7, decent shape, needs new cover, includes chemicals, \$300. Morrison, 323-9088.

HOYER HYDRAULIC LIFT, back saver, transfers non-ambulatory patients, parts, instructions included, excellent condition, \$600. Brackhahn, 970-264-4923.

DASH COVER, Greige, for '97 Infiniti I-30, excellent condition, very new, \$12. Homer, 836-5043.

LOBO SEASON TICKETS, basketball, 2 chair-backs. Bass, 856-2407.

BROOKS & DUNN TICKETS, 2, State Fair, 9/6/02, great seats, \$36 ea. Beck, 281-3908.

BASS GUITAR, Fender Jazz bass copy, fretless w/fret line markers, black body, white pick guard, like new, \$175. Kureczko, 286-4426.

BABY FURNITURE: oak crib, changing table & dresser set, excellent condition, \$325. Owens, 823-9099.

LEATHER COUCH, dark blue, excellent condition, paid >\$2,000, asking \$500. Aubert, 286-9173.

SOUTHWEST AIRLINE TICKET, roundtrip, good anywhere Southwest flies, expires 7/26/03, \$300. Case, 856-7715.

SEMI-RECLUBBENT CYCLE, stationary, Tunturi Model F515, includes large seat, meter for speed/time, \$125. Jones, 899-0642.

## How to submit classified ads

**DEADLINE: Friday noon before week of publication unless changed by holiday. Submit by one of these methods:**

- E-MAIL: Michelle Fleming (classads@sandia.gov)
- FAX: 844-0645
- MAIL: MS 0165 (Dept. 12640)
- DELIVER: Bldg. 811 Lobby
- INTERNAL WEB: On Internal Web homepage, click on News Center, then on Lab News frame, and then on the very top of Lab News homepage "Submit a Classified Ad." If you have questions, call Michelle at 844-4902. Because of space constraints, ads will be printed on a first-come basis.

### Ad rules

1. Limit 18 words, including last name and home phone (We will edit longer ads).
2. Include organization and full name with the ad submission.
3. Submit the ad in writing. No phone-ins.
4. Type or print ad legibly; use accepted abbreviations.
5. One ad per issue.
6. We will not run the same ad more than twice.
7. No "for rent" ads except for employees on temporary assignment.
8. No commercial ads.
9. For active and retired Sandians and DOE employees.
10. Housing listed for sale is available without regard to race, creed, color, or national origin.
11. Work Wanted ads limited to student-aged children of employees.
12. We reserve the right not to publish an ad.

ROCKER/RECLINERS, \$40 ea.; polished brass chandelier light fixture, \$20; office desk, \$25; 10-gal. fish tank, \$10. Redmond, 823-2109.

WATERBED MATTRESS, king, extra firm, \$75; 14-ft. aluminum boat, trailer, trolling motor, \$525; telescope, Meade model 227/NW, \$75. Zirzow, 281-9896.

BASS GUITAR, Hondo, \$150. Douglas, 281-9843.

DIGITAL CAMERA, Nikon Coolpix 5000, lots of accessories, 6 mos. old, spent \$1,700, asking \$1,250. Lutheran, 550-8386.

OAK CABINET, double-door, 30" x 30" x 16", \$125; queen-size bed, w/headboard & footboard, \$295; Baldwin organ, \$395. Polito, 298-3859.

## TRANSPORTATION

'91 NISSAN STANZA, 4-dr., 5-spd., power everything, white, runs great, good condition, \$1,250 OBO. Cancilla, 480-6730.

'95 FORD CONTOUR SE, AC, PS, cruise, moon roof, 6-disc CD changer, premium wheels, 63K miles, \$6,000. Verardo, 296-6602.

'98 FORD CONTOUR, 4-dr., cruise, 61K miles, \$5,999. McLaughlin, 881-6455.

'95 VOLKSWAGEN GOLF, red, 5-spd., AC, new tires, 74K miles, excellent condition, \$6,500 OBO. Sanders, 797-2935.

'95 MERCURY COUGAR XR-7, V8, AT, all power, garage kept, 76K miles, just like new, \$5,900. Rogers, 489-2621.

'71 VW BUG, classic, runs great, body & interior OK, \$2,200 OBO. Oldewage, 899-0058.

'99 FORD F250, 4x4, Lariat, short bed, 4-dr., ext. cab, 7.4L, towing, tool box, custom wheels, 3-in. lift. Sanchez, 238-5363.

89 MAZDA MX-6, 5-spd., AC, PW, moon roof, CD, 2 new tires, 80K miles, \$2,750 OBO. Fernandez, 822-0377.

'97 DODGE RAM 1500, X-cab, 2WD, AC, AM/FM/CD, trailer/tow package, shell, manual trans., 64K miles, \$10,500. Clise, 822-1890.

'01 JEEP WRANGLER, 4x4, 5-spd., 4-cyl., hardtop, cloth, steering & convenience groups, good condition, 21K miles. Dudley, 255-3626, pete.dudley@comcast.net.

'85 PORSCHE 944, new belts & mounts, needs paint, runs excellent, 84K miles, \$6,500. Padilla, 332-8248.

'77 GMC PICKUP, \$2,500; '93 Eagle Vision, \$3,500; VW dune buggy, w/T bucket fiberglass body, \$2,500. Schear, 865-6457.

'83 BMW 528e, 5-spd., leather, gray, all records, garage kept, original owner, \$2,800. Sansone, 296-7945.

'98 FORD F250, 3/4-ton, long bed, bed liner, PS, PB, AC, gold, immaculate, 82K miles, \$1,000 below book at \$7,700. Stafford, 681-4082.

'94 CHEVROLET BERETTA, 2-dr. coupe, V6, loaded, new brakes, front & rear struts, white, 100K miles, \$3,600. Sturgeon, 281-9035.

'97 SATURN, gold, 4-dr., 5-spd., AC, PL, keyless/alarm, AM/FM/cassette, excellent condition, 73K miles, \$5,000 OBO. Durfee, 379-3707.

'95 COROLLA, 4-dr., 4-cyl., AT, AC, PW, AM/FM/cassette, great condition, 107K miles, \$5,444 OBO. Rogahn, 299-2710.

'89 GMC 3/4-TON, w/trailer, towing package, brakes, 1-owner, 4-spd., w/low posi-traction, no slip differential, 120K miles, \$4,900. Maynard, 865-1288.

'90 HONDA CIVIC, many new parts, great running condition, second owner, great student car, 152K miles. King, 286-6228.

'93 DODGE CONVERSION VAN, B250, 4 captain's chairs, white/maroon, excellent condition inside & out, 68K miles, \$7,000. Serna, 899-9618.

'91 MAZDA 626 DX SEDAN, blue, 5-spd., PB, CC, roof bike rack, 116K miles, \$2,000 OBO. Dawley, 292-9249.

'91 GMC 4X4 SLE, ext. cab, short bed, AT, loaded, 130K miles, great condition, \$5,800. Wolf, 281-0287.

'69 FORD FALCON, 4-dr., red, 112K original miles, \$3,500 OBO. Hrzich, 352-6754.

'96 SUZUKI SWIFT, 4-cyl., 2-dr., AT, AC, AM/FM/cassette, plum w/gray interior, approx. 140,733 miles, bids accepted through 9/6/02, right to refuse bids, sold as is. SLFCU, 237-7386.

'90 HONDA CIVIC HATCHBACK, 2-dr., 4-spd., AM/FM/cassette, 122K miles, new brakes/drums, \$2,000 OBO. Wolfe, 821-2684.

'94 SATURN SL2, AT, traction control, Mobil 1 since new, gold, 160K miles, excellent condition, \$2,750 OBO. Kravitz, 867-3676.

'00 FORD TAURUS, all power, AT, AC, alloy, 13K miles, \$10,900. Brown, 872-2103.

'93 HONDA DEL SOL S, 5-spd., AC, alarm, cover, CD, blue, 122K miles, NADA retail \$5,850, asking \$4,800. Crow, 821-0956.

'88 TOYOTA PICKUP, w/shell, 4x4, 5-spd., V6, sunroof, HD rear bumper, stereo w/200W amp, 129K miles, excellent condition, \$5,200. Kociscin, 298-8845.

'93 GMC SUBURBAN, 4WD, AC, PW, PL, cruise, running boards, towing package, original owner, 133K miles, excellent condition, \$9,100. Gallagher, 823-2674.

'93 TOYOTA COROLLA, 4-dr., AT, AC, AM/FM/cassette, clean interior, could use minor front work, 75K miles, good condition, \$3,750. Franklin, 292-6951.

## RECREATIONAL

'87 SOUTHWIND MOTORHOME, 29-ft., 47K miles, excellent condition, \$14,950. Williams, 344-9276.

TRACKER BOAT, w/canopy, Pro Angler V-16, fully loaded, never been used, \$15,000 OBO. Chacon, 281-1196, ask for Margaret or Mark.

ELECTRIC FISHING TROLLING MOTOR, Motorguide, bow mount, foot control, 24-lb. thrust, \$50. Kalin, 883-1639.

'83 SHASTA RV, single-axle, 16-ft., self-contained, cute, refrigerator, stove, shower, toilet, \$4,000 OBO. Talandis, 877-0626.

BOAT, 12-ft. aluminum, lightweight, ideal for cartop, \$300 OBO. Madsen, 294-3235.

'99 HOLIDAY RAMBLER, motor home, 35-ft. lots of extras, tow dolly included, 15K miles, excellent condition, \$67,000. Colson, 864-4308.

'91 XR250R DIRT BIKE, Pro Taper handle bars, FMF Megamax exhaust, O-ring chain, good condition. Sells, 463-5662.

'91 KAWASAKI GPZ1100, original GPZ, original owner, big bore kit, fuel-injection, lots of extras/spares, \$2,975. Barnard, 856-1952.

'00 POLARIS VIRAGE TX, low hours, w/trailer & cover, \$6,200. Schoeneman, 281-0036.

BIKES: Giant "Iguana" mountain, \$100; Raleigh Road, \$85; Silver Mongoose, dual suspension, mountain, \$100. Nelson, 823-1359.

'98 HONDA VALKYRIE, 1520cc, bought new '00, stock windshield, hard bags, new rubber, w/1-yr. warranty, 4,700 miles, excellent condition, \$9,300. Chavez, 379-6526.

MOUNTAIN BIKE, woman's, 26-in. Diamondback, red, excellent condition, \$75 OBO. Case, 293-5466.

## REAL ESTATE

2-BDR. CONDO, 1-3/4 bath, pool, many extras, in Rio Rancho, adults only, call for details. Saavedra, 892-0275, ask for Pat.

HOUSE FOR RENT, Cedar Crest, 1-yr. lease, 1,650 sq. ft., wooded half-acre, no smokers or cats please, \$950/mo. Linebarger c/o Casteel, 830-2444.

40 ACRES, \$109,000; 30 acres, \$99,000, wooded w/meadow, subdivided, water-witched for water, positive. Rowe, 286-5432.

2-BDR. TOWNHOME, 2 baths, 985 sq. ft., oversized lot, located in Taylor Ranch, \$89,900. Sanchez, 899-5095.

3-BDR. HOME, 2 baths, 2-car garage, freshly painted, 1,568 sq. ft., Edgewood, 2.5 acres, \$145,900. Leonard, 298-5184.

2 ACRES, East Mountains at 19 Maplewood Ct., utilities, views of South Mountain & Sandias, \$35,000. Rumpf, 298-7839.

CONDO, new, 2,320 sq. ft., 1,320 sq. ft. living, 1,000 sq. ft. C-1 commercial work area, 600-sq.-ft. garage. Brown, 459-4315, ask for Bill.

4-BDR. HOME, 2-1/2 baths, 2,680 sq. ft., study, pool, NE/UNM area, by park/golf course, reduced, \$249,900. Chapman, 271-9686.

3-BDR. HOME, 2-1/2 baths, 2-story, 2,474 sq. ft., 1-acre horse property, 2-car garage, 30' x 40' heated shop, barn, Bosque Farms, FSBO, \$225,000. Van De Valde, 293-2722.

3-BDR. HOME, 1-3/4 baths, 2-car garage, LR, DR, FR/FP, new carpet, good school, quiet NE Heights area, \$129,000. Lin, 821-6183.

2-BDR. MOBILE HOME, 2 baths, 2 covered decks, covered carport, hot tub, landscaped, near base, 4 Hills Mobile Home Park, \$24,500. Scharberg, 292-5068.

4-BDR. HOME, 1 bath, 2,050 sq. ft., renovated kitchen, great views, 2520 Madre Drive, FSBO, \$207,500. Maestas, 275-2766.

3-BDR. NEW HOME, 2-1/2 baths, many upgrades, gated community, Indian School & Washington, \$159,900. Archibeck, 255-4058, ask for Janine.

## WANTED

CALCULATOR, HP-41CX, programmable, including HP-82120A rechargeable battery pack & other accessories, if available. Hughes, 299-6674.

VISITING PROFESSIONAL wants to rent 1-bdr., furnished, charming, townhouse, Eubank/Academy area, w/1-car garage, bus stop one block away. Wagner, 858-1883.

SAWYER 35MM SLIDE TRAYS, used, 100-capacity rotary type, 25 needed. Hall, 858-1669.

DIRT BIKE, used, fair condition, street-legal not important, just for putting around & giving kids rides. Cocain, 281-2282.

GOOD HOME, 2 huskies, neutered male, spayed female, keep together, 1-1/2 years old, well trained. Wanya, 294-2050.

OVERHEAD PROJECTOR, type w/spare bulb preferred, bulb(s) must work. Brophy, 265-1060.

FEMALE ROOMMATE, to share newly remodeled house, 3 blocks from UNM, \$450/mo +utilities, available 8/15/02. Brown, 265-0406.

GOOD HOME, for puppy, appears Chihuahua/min. pincher, house-trained, cute, friendly, good w/kids, ASAP. Garcia, 839-4227.

STORAGE SPACE, covered, preferably indoor, for vintage automobile, looking for long-term storage, cost-negotiable. Antonich, 271-1635.

POKEMON CARDS, for a new collector & his buddies, "ones with lots of damage." Mullaney, 259-8381.

USED EXERCYCLE, very cheap. Leeman, 281-7949.

GRAPHING CALCULATOR, used, TI-83, for high-school student. Oliver, 281-4530.

## LOST & FOUND

FOUND: necklace, in 960 parking lot on 8/13/02. Greives, 845-7270, ask for Kenn, khgreiv@sandia.gov.



# The opera singer is a physicist – or the physicist is an opera singer?

*Sandian-by-sabbatical Dan Boye sings praises of science and lectures (really) on science of singing*

By Neal Singer

Davidson College in North Carolina has 1,700 students and is frequently mentioned by *US News and World Report* on the same terms as Swarthmore and Amherst. Yet, unlike these intellectually excellent but athletically challenged small colleges, Davidson has a Division 1 basketball team that plays behemoths like Duke (a perennial powerhouse) and Ohio State.

So, how does it do against Duke?

"We lose," shrugs Davidson's Dan Boye, a college physicist taking his sabbatical at Sandia. "But we almost beat Ohio State this year in the NCAA Tournament at the UNM Pit." The team in fact lost by only 5 points.

Dan, chairman of Davidson's physics department, is no stranger to dualities. He works at Sandia — at the invitation of Sandia senior scientist Jeff Brinker (1846) — to advance his knowledge of solgels, but he also sings in opera, musical theater, and as an oratorio soloist.

His professional singing brings him pay comparable to his salary at Davidson, but only when he sings, which is sporadic, and health and retirement benefits are not included. Still, despite his interest in science, one gets the impression that — all worldly things being equal — he might gravitate toward opera, were it not for his need to exercise both the imaginative and analytical sides of his brain.

The necessity arose early. He sang in church choirs at the age of six and is a remote relative of folk singer Tennessee Ernie Ford. Yet he was born into a family of physicists, including his brother and sister-in-law who work for Sandia — Andy (5710) and Lydia (5914). His father was a polymer physicist for Eastman Kodak. A great-uncle was also a physicist.

Thus, he favors music that is complex, though at command performances he may sing "Sixteen Tons" to warm up his audience.

## Performing at highest possible level

He prefers singing pieces like Brahms' *Requiem* with an orchestra, because "the refinement of music is at such a high level that you achieve a certain artistry you don't get from just jamming in the garage or singing in the shower," he says.

He asks his listener to imagine being part of a performance by 80 instrumentalists and 120



DAN BOYE in costume as Don Giovanni.

singers "who have dedicated their lives to performing at the highest possible level.

"Being a member of an ensemble like that is one of the ultimate excitements you can have," he says. "There's an intensity you don't find in normal life."

Then there's opera, where life is distilled down to the essence of the few most important events that a performer can live in literature.

"The opera *Othello* is the shortened version of a Shakespearean play," he says. "There's no way you could sing every verse in that play as written. It would take many hours. So the librettist distills the important words and uses music to convey the jealousy and treachery, the emotion of the drama. The words very easily tap into human experiences, and those musical strains

you hear — your soul ties into them very easily."

He defends abbreviations of great literature because of what he feels is the importance of music.

"Why is there music on almost all the radio stations?" he asks. "Music is a common mode of communication. When the Star Spangled Banner is sung, why do people cry? It's the same song, sung so many times; what is it that pulls people together? Not just the words, surely."

He prefers that music be joined with motion. For this reason, he finds opera more enjoyable than symphonic performances. "We are such a visual society, we rely more on our eyes than our ears; so it's hard just to listen." The radio, he points out, is generally listened to as people are driving or working — visual experiences complementing the aural. "Music moves me and I want to move," he says.

What is it about words sung rather than spoken that move an audience? A technical difference is the amount of time spent per word, vocalizing vowels rather than consonants. "In singing you can spend most time on vowels, rather than pursuing the equal emphasis of speech. So you can extend a song to longer meter than you can a drama. The artful lengthening of words ties within it the tensions and harmonies that go along with our emotions."

This interest in music and science — combining left and right brain — is more common than most people realize, says Dan. A surprising number of lab researchers have spoken with him about their own musical experiences after learning Dan's background. New realms of conversation arise that would not come about in laboratories, without the aid of music.

He gave two lectures at Sandia in recent weeks on the "Science of Singing." He discussed the actual shape of the vocal cords — really lips, not cords, he says, made of muscles, ligaments, and epithelial tissue contained in a v-shaped cartilage structure and operated on by a complex set of muscles. True to his science background, he also described musical instruments (including the voice) in terms of a power supply, oscillator, and resonator model.

In Jeff Brinker's lab, he uses equipment unavailable at Davidson College to adjust the electrical and optical properties of solgel thin films. The tricky films contain ordered arrays of gold nanoparticles that apparently are uninfluenced by his golden voice.

## Feedback

### Are Labs' Benefits booklets available on CD?

**Q:** I would like to know if the Sandia benefits booklets are available on a CD? It also might be possible to have them on the Web so the updates could just be posted electronically and e-mail could be sent out notifying everyone that a "new issue" has been made. Are there plans to do this?

**A:** The Sandia benefits booklets, also known as Summary Plan Descriptions, are not currently available on a CD but we will evaluate the feasibility of doing so. They are, however, available on the Web and have been for several years. You can access them from the Benefits home page at <http://www-irn.sandia.gov/HR/Benefits/pgMain-Frame>, from the "My Benefits" site at <http://net-dynam.gov/NetDynamics/nd/benefits/pgMain-Frame>, or by clicking on "Benefits" under "About Me" on the Sandia Tech Web home page. We typically announce the "new issues" in the *Sandia Daily News*. We will also continue to publish them in hard copy form because they need to be available to all participants and some of our employees and retirees and their dependents do not have Web access. — Don Blanton (3000)

## Sandia's Mentor Protégé Program celebrates a year of accomplishments

Protégés, mentors, and business service advisors of Sandia's Mentor Protégé Program celebrated a year of accomplishments Aug. 8 during a celebration at the Sheraton Uptown.

The Mentor Protégé Program, founded a year ago, assists small businesses that want to improve their business practices and procedures to become better, more effective suppliers to large organizations.

This year six companies from across the state were selected to participate in the pilot program. They were paired with Sandia employees or successful suppliers to identify potential problems and find solutions.

On hand to congratulate program participants were VP 1000 Al Romig and VP 10000 Frank Figueroa, along with Bob Braden, National Nuclear Security Administration director of procurement.

**Protégés:** Leroy Gomez, TMC Design Corporation, Las Cruces; Richard Luarkie,

Digital Migration LLC, Blanca; Elizabeth McNally, Animas Environmental Services, Farmington; Nels Johnson, Eberline Services, Albuquerque; Richard Meyer, CIC Photonics, Albuquerque; and Phil Armenta, Advanced Clinical Engineering, Bloomfield.

**Mentors:** Sandia: Mark Retter (2612), Karl Ricker (12336), and David Stafford (10256); Bob Quintanilla, Information Assets Management; Krishan Wahi, GRAM Inc.; Fred Mondragon, and L&M Technologies.

**Business Service Advisors:** Fred O'Chesky, Southwest Public Affairs & Southwest Spectra, Inc.; George Richmond, Richmond Corporate Services; Kim Monte, The Aspen Group; Nora Armijo (10205) and Ken Holley (2031-2), Sandia; and Tim Kelly and Pat Kiesel, REDW.

*Small businesses or Sandia employees interested in applying for the 2002 - 2003 Mentor Protégé Program can contact Toni Leon Kovarik (1302) at 284-9549 for further information.*